Patil N et al. GAIMS J Med Sci 2024;4(1) (Jan-Jun):92-102
Online ISSN: 2583-1763

Original Research Article

Functional and Radiological Outcome in Lower End Radius Fractures – Our Experience

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ABSTRACT

Background: Distal radius fractures are among the most common upper extremity fractures and the second most common overall fracture in Orthopaedics and trauma. Deciding between non-operative or operative management depends on the patient factors, fracture pattern, displacement and the treating orthopaedic surgeon. The objective of our study was to assess the functional and radiological outcome in lower end radius fractures, treated or untreated at the end of 1 year follow up.
Material and methods: Our study was a prospective hospital-based study during the period January 2021 and December 2022. All closed lower end radius fractures meeting the inclusion/exclusion criteria and willing for follow up assessments were included in the study. Study subjects were divided into 2 groups- Treated/Operated group & Untreated/Non-operated group of patients. All patients were followed up at 6 weeks, 3 months and 1 year post injury and their functional and radiological outcomes were assessed and compared between the 2 groups.
Results: A total of 100 patients were included in the study who met the required inclusion/exclusion criteria. There was 3 times more incidence among males as compared to females. Mean age was 45.1 yrs. High energy injuries were more frequent in younger patients. Frykman type I>II>VIII were the common type of fracture pattern noted in our study. In our study of 100 patients, 41 patients did not undergo operative intervention and 59 patients underwent some form of operative procedure. We observed that the acceptance of operative intervention was more in younger patients. Based on radiological criteria, 72 patients had excellent radiological outcome overall, out of which 49 patients belonged to operative group and only 23 patients belonged to non-operative group. There was only marginally better PRWE – Patient Rated Wrist Evaluation scores in operated group of patients as compared to non-operated group.
Conclusion: Lower end radius fractures have a bimodal age of incidence with a peak in younger patients usually associated with high velocity injuries, and in elderly patients usually secondary to low velocity injuries mostly due to falls. Based on Frykman classification, the more severe the injury there is more acceptance of operative intervention. Operative intervention results in better radiological outcome at 1 year.

Keywords: Distal Radius, PRWE, Frykman, Plating

INTRODUCTION

Distal radius fractures are among the most common upper extremity fractures and the second most common overall fracture in Orthopaedics and trauma. It represents approximately one-sixth of all the fractures treated in the emergency department.[1]

They typically present in a bimodal distribution: young and the elderly. In younger patients, common mechanisms include fall from height, RTA, or any other athletic injury. High-energy injury mechanisms like these often lead to marked displacement and comminution in a bone of normal quality and is often managed operatively.[2]

In the elderly population, the incidence correlates with osteopenia and increasing age. The mechanism of injury in them involves more commonly a simple fall onto their outstretched hand. Risk factors include decreased BMD, female sex, early menopause and other factors contributory to osteoporosis.[3]

DRF can be extraarticular or intraarticular. Most are extraarticular and result from a fall on their outstretched hand and might not need operative fixation.
Thus, it is important to categorize the fracture type and injury severity to serve as a guideline for treatment and prognosis of DRF. Commonly used classification system includes Fernandez classification, Frykmann classification, AO classification, Gartland and Werley classification, Melone classification etc., but they don't always guide us in the appropriate management of distal radius fracture.[4]

However, restoration of wrist function and maintaining the radiocarpal and radioulnar joint mechanics at the maximum obtainable level has always been the objective.[5] The ultimate goal of the treatment for distal radius fractures is to obtain sufficient pain-free motion, allowing return to activities while minimizing the risk for future degenerative changes or disability[4]. However, deciding between non-operative or operative management finally depends on the patient factors, fracture pattern, displacement and the treating orthopedic surgeon.

Objectives

1. To assess the functional and radiological outcome of lower end in radius fractures, treated or untreated at 1 year follow up.

2. To analyse the results and identify subgroups of radius fractures in different age groups benefitting from different treatment modalities

MATERIAL AND METHODS

Study Area: Our study is a hospital based prospective study conducted in SDM College of Medical Sciences & Hospital, Dharwad after ethical clearance

Study period: Study was carried out from Jan 2021 to December 2022. Patients attending to the Department of Orthopaedics in SDM College of Medical Sciences & Hospital, Dharwad who were diagnosed with distal radius fracture, and fulfilling the said inclusion and exclusion criteria and willing for the study, were included in the study.

Inclusion criteria
All lower end radius fractures presenting to SDM Medical College and Hospital Dharwad (Outpatient, Inpatient and Casualty), age >18 years and treated or refused any modality of treatment and available for follow up.

Exclusion criteria
1.Open type fractures
2.Age <18 years
3.Any other fracture of the same limb

Sampling method
A total of 100 patients were included in the study. The initial basic details of those patients who fulfil the basic criteria for the study were collected from the patient and patient's attendant who visits the in-patient, out-patient or emergency department at SDM Hospital. Case history were recorded in a specially designed Case Record Form (CRF) by taking history of illness and by doing detailed clinical examination, radiological examination and relevant investigations.

All patients who were managed operatively, non-operatively or refused any modality of treatment in the hospital but were willing for follow ups were included in the study. Functional and radiological outcomes were assessed using the PRWE score and Sarmiento et al modification of Lindstorm criteria for radiological outcome at 1 year follow up. All the cases were followed up at 6 weeks, 3 months and 12 months. Results were analysed both clinically & radiologically using appropriate statistical methods. Study subjects were explained about the aims and objectives of the study and informed consents were obtained from them. Every subject was personally interviewed using the proforma.

Treated/operated patients were those patients who underwent operative management at our hospital as per the treating doctor. Untreated/non-operated

patients were those patients who did not undergo any operative management and were managed with a below elbow or an above elbow POP slab/cast, or any patient who refused any form of treatment at our hospital but were willing for follow up.

Statistical Analysis: Data was analyzed using SPSS version 20. Mean, median and standard deviation was calculated and Chi square test was applied wherever necessary as a test of significance.
Institutional Ethical Committee approval was taken prior to the study.

RESULTS

A total of 100 patients were included in the study. All 100 patients completed the expected one year follow up. Patients were evaluated in terms of their functional outcome and the restoration of wrist joint radiological parameters at 6 weeks, 3 months and 12 months follow up post the injury.

PRWE scoring has been used to assess the clinical outcome in these patients at the end of 1 year follow up. Radiological outcome assessment was done according to Sarmiento et al modification of Lind Storm Criteria. The data obtained was analysed to study the functional and radiological outcome of distal end radius fractures, and also their correlation.

The correlation between age, sex, mode of injury, Frykman classification with functional/radiological outcome were assessed. Also, incidence of complications has also been assessed and studied.

A total of 100 patients were included in the study, of which 75 patients were males and 25 patients were females.

Out of 100 patients, 49 patients had injury on the right side as compared to left side with 51 patients

In our study with 100 patients, there were 23 patients below the age of 30 years, 27 patients between the ages 31-45, 30 patients between the ages 46-60 and 20 patients above 61 years of age. We noticed almost an equal distribution of patients in all age groups.

Table 1: Mode of injury wise distribution of patients

Age (Years)	**Number (%)**
20-29	79 (49.4%)
30-39	62 (38.8%)
40 above	19 (11.9%)
Total	160 (100%)
Education	**Number (%)**
Illiterate	23 (14.4%)
Primary	100 (62.5%)
Secondary	37 (23.1%)
Total	160 (100%)
Marital Status	**Number (%)**
Married	137 (85.6%)
Unmarried	23 (14.4%)
Total	160 (100%)
Religion	**Number (%)**
Hindu	59 (36.9%)
Muslim	17 (10.6%)
Buddhist/New Buddhist	80 (50%)
Others	4 (2.5%)
Total	160 (100%)
Socioeconomic Status	**Number (%)**
Upper (I)	0 (%)
Upper Middle (II)	0 (0%)
Lower middle (III)	17 (10.6%)
Lower Upper (IV)	143 (89.37%)
Lower (V)	0 (0%)
Total	160 (100%)

Table 2: FRYKMAN classifications wise distribution

FRYKMAN classification	No of patients	% of patients
I	28	28.00
II	27	27.00
III	3	3.00
IV	13	13.00
V	4	4.00
VI	5	5.00
VII	1	1.00
VIII	19	19.00
Total	100	100.00

Table 3: Management wise distribution of patients (figure 3,5,6 & 7)

Management	No of patients	% of patients
Volar plating	34	34.00
Ex fix + K-wires	2	2.00
Ex fix + Plating	1	1.00
K-wires + plating	4	4.00
K-wires	18	18.00
Cast	41	41.00
Total	100	100.00

Statistical analysis

There was no statistical significance of affected side or gender in both the operated and non-operated group of patients.

About 70% of patients with extra articular distal radius fractures did not undergo operative management as compared to intraarticular fractures where 93% of patients underwent operative management.

All patients with distal end radius fractures belonging to Frykman class V-VIII, all 29 patients underwent operative management. P value was found to be significant for Frykman classification in operative and non-operative groups. (Table 5)

Table 4: Incidence of Complications

Complication	No. of patients	% of patients
Pintract Infection	0	0
Stiffness of wrist	15	15
Stiffness of Fingers	8	8
Residual Pain	11	11
Malunion	3	3
Non union	2	2
Implant removal	2	2

42 patients from operated group had PRWE score of <10 while also 24 patients from non-operated group also had a score <10. However, there was no statistical significance for range of PRWE scores for operative and non-operative groups. (Table 6)

Out of 100 patients, 72 patients had excellent radiological outcome of which 49 patients belong to operative group as compared to only 23 patients in non-operative group. About 83% of the patients in operative group had excellent outcome while only 32% of the patients from non-operative group had excellent result& P value was found to be statistically significant for radiological outcome in operative and non-operative group of patients. (Table 7)

P value was found to be significant for palmar tilt, radial length and radial inclination in operated and non-operated group of patients at the end of 12 months. (Table 8)

Table 5: Comparison of operative and non-operative groups with age

Age groups	Operative group	%	Non-operative group	%	Total	%	p-value
<=30yrs	16	69.57	7	30.43	23	23.00	0.0001*
31-45yrs	14	51.85	13	48.15	27	27.00	
46-60yrs	19	63.33	11	36.67	30	30.00	
>=61yrs	10	50.00	10	50.00	20	20.00	
Min	18.00		18.00		18.00		
Max	81.00		79.00		81.00		
Mean	44.14		46.49		45.10		
SD	17.22		16.15		16.75		
Total	59	59.00	41	41.00	100	100.00	

Table 6: Operative groups with PRWE

PRWE	Operative group	%	Non-operative group	%	Total	%	Chi-square	p-value
1--10	42	71.19	24	36.36	66	66.00	1.9110	0.3850
11--20	14	23.73	13	48.15	27	27.00		
>=21	3	5.08	4	57.14	7	7.00		
Total	59	100.00	41	41.00	100	100.00		

Table 7: Operative groups with radiological findings

Radiological findings	Operative group	%	Non-operative group	%	Total	%	Chi-square	p-value
Excellent	49	83.05	23	31.94	72	72.00	11.1850	0.0110*
Good	8	13.56	11	57.89	19	19.00		
Fair	0	0.00	4	100.00	4	4.00		
Poor	2	3.39	3	60.00	5	5.00		
Total	59	100.00	41	41.00	100	100.00		

Table 8: operative groups with R. length, palmar tilt and R. inclination at time of injury by independent t test

Variables	Operative group		Non-operative group		t-value	p-value
	Mean	SD	Mean	SD		
R. Length	4.76	4.25	7.39	3.51	-3.2574	0.0015*
Palmar tilt	2.88	17.02	-1.10	11.06	1.3152	0.1915
R. Inclination	9.47	7.36	11.88	6.44	-1.6896	0.0943

Table 9: Operative groups with changes from time of injury to12 months R. length, palmar tilt and R. inclination by Mann-Whitney U test

Variables	Operative group			Non-operative group			Z-value	p-value
	Mean	SD	Mean rank	Mean	SD	Mean rank		
R. Length	6.79	4.32	62.19	2.76	3.33	33.68	4.8287	0.0001*
Palmar tilt	3.92	16.32	48.03	4.80	6.72	54.05	-1.0162	0.3095
R. Inclination	10.13	7.33	59.42	5.10	5.99	37.67	3.6829	0.0002*

Table 10: Operative groups with mean of range of motion parameters at 12 months by independent t test

ROM variables	Operative group		Non-operative group		t-value	p-value
	Mean	SD	Mean	SD		
Flexion	67.12	9.39	65.37	9.64	0.9082	0.3660
Extension	67.37	9.75	68.90	5.86	-0.8970	0.3719
Supination	71.61	9.40	69.76	9.01	0.9867	0.3262
Pronation	68.39	8.53	68.54	4.51	-0.1007	0.9200
Radial deviation	18.98	2.59	18.41	3.94	0.8704	0.3862
Ulnar deviation	28.22	3.91	26.10	5.30	2.3032	0.0234*

Table 11: Operative groups with PRWE by Mann-Whitney U test

PRWE	Operative group			Non-operative group			Z-value	p-value
	Mean	SD	Mean rank	Mean	SD	Mean rank		
PRWE	8.71	10.14	43.61	11.85	8.33	60.41	-2.8454	0.0044*

Table 12: Association between classification or types of fracture and radiological outcome

Radio Outcome	I- II	%	III-IV	%	V-VI	%	VII-VIII	%	Total
Excellent	35	48.61	12	16.67	8	11.11	17	23.61	72
Fair	4	100.00	0	0.00	0	0.00	0	0.00	4
Good	13	68.42	4	21.05	1	5.26	1	5.26	19
Poor	3	60.00	0	0.00	0	0.00	2	40.00	5
Total	55	55.00	16	16.00	9	9.00	20	20.00	100

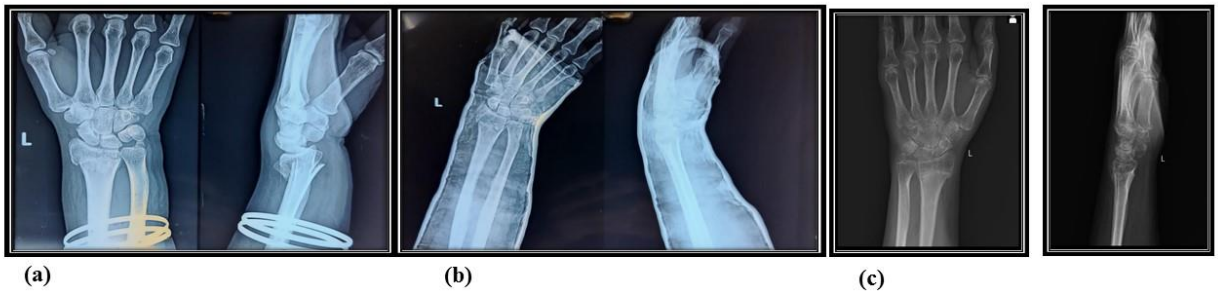

Figure 1: Radiological outcome a) distal end radius fracture b) closed reduction & plaster immobilisation c) end of one year

Figure 2: Functional outcome at 1 year a) supination & pronation b) dorsiflexion & plantar flexion c) ulnar & radial deviation

Figure 3: Distal end radius fracture in 26 years old treated by open reduction internal fixation with screw and plate

Figure 4: Functional outcome at 1 year a) dorsiflexion & plantar flexion of wrist b) supination & pronation c) ulnar & radial deviation

Figure 5: External fixation device for distal end radius fracture

Figure 6: k wire fixation for distal end radius fracture

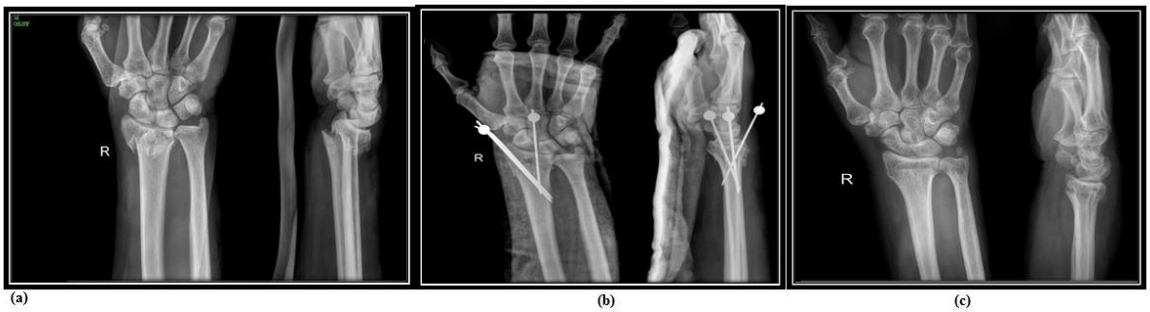

Figure 7: Radiological outcome a) distal end radius fracture b) post fixation with k wire c) at end of one year

Figure 8: Functional outcome at 1 year a) dorsiflexion & plantar flexion of wrist b) supination & pronationc) ulnar & radial deviation

DISCUSSION

Lower end radius is one of the most common orthopaedic injuries seen by orthopaedic practitioners in day-to-day practise. The bimodal age incidence with osteoporosis associated low velocity fractures in elderly and displaced high velocity injuries are well known and this is also reflected in our study. There is a hesitancy to any mode of operative intervention in elderly especially in India due to poor socioeconomic status and fear of operative procedures, so the acceptance of residual deformity and limitation of functional capacity is accepted. This study was undertaken to assess the functional and radiological outcome in all the lower end radius fractures at 1 year post injury in both groups of patients who underwent operative procedures or who refused operative procedures and were treated with cast or slab on OPD basis without reduction under anaesthesia. The research hypothesis was that in those patients who did not undergo any operative intervention or reduction under anaesthesia, they would have worse functional and radiological outcomes at the end of 1 year

In our study of 100 patients, 41 patients refused operative intervention and 59 patients who underwent some form of operative procedures. We observed that the acceptance of operative intervention was more in younger patients, that is in patients less than 30 years 70% opted for operative intervention, whereas in patients aged over 60 only 50% opted for operative procedures. This is in line with the general trend in India where people aged above 60yrs. opt for non-operative intervention even though there is a risk of functional impairment. In our study when all fractures irrespective of age were assessed regarding treatment modalities based on Frykman classification (Table 2) It was observed that in Frykman type VII and VIII fractures all patients accepted operative intervention. This may be due to the patient's awareness regarding the severity of injury pattern. In our study when we compared outcomes based on radiological criteria,72 patients had excellent radiological outcome overall out of which 49 patients belonged to operative group and 23 patients belonged to non-operative group. This indicates that operative intervention results in better radiological outcome compared to non-operative group (figure 1). The functional outcome compared based on PRWE score at the end of 1 year showed a slightly better outcome in operative group. The comparison with other similar studies is presented below.

Mean age in our study was 45.1 yrs. and is comparative to other studies. In our study, there is a 3:1 distribution in sex ratio(M/F) for incidence of distal radius fractures. In other Indian studies, P. Ravi Shankar et al and Gupta and Yadav et al have noted a 2:1 ratio distribution in sex ratio(M/F). However, in western studies, there is more incidence among females as compared to males.

Table 13: Comparison of clinical outcome using PRWE score at 1 year

Study	Mean PRWE Score (SD) at 12 months
Laohaprasitiporn et al (Thailand)	Plating- 4.6 (2.9)
Costa et al (UK)	K-wire - 8.3 (12.5) Plating – 11.3 (15.6)
Matthew L. Costa et al (UK)	Cast - 21.2(23.1) K-wires – 20.7(22.3)
Our study	Operated - 8.71 (10.14) Non-operated - 11.85 (8.33)

Table 14: Comparison of Radiological outcome

Study	Excellent	Good	Fair	Poor
P. Ravi Shankar et al (India)	87.5%	12.5%	-	-
Yogesh et al (India)	90%	5%	5%	
Our study	72%	19%	4%	5%

CONCLUSIONS

Lower end radius fractures have a bimodal age of incidence with a peak in younger patients usually associated with high velocity injuries, and in elderly patients usually secondary to low velocity injuries mostly due to falls.

Based on Frykman classification, the more severe the injury there is more acceptance of operative intervention.

Operative intervention results in better radiological outcome at 1 year.

There are Marginally better functional outcomes based on PRWE criteria at 1 year in operative group compared with non-operative intervention
Hence, operative management should be considered in lower end radius fractures according to the treating doctors decision based on the age, fracture pattern and demands of the patient.

Drawbacks and limitations

The main drawbacks of our study are limited number of untreated patients who were not willing for any form of treatment at our hospital and we have not directly compared the different forms of treatment for lower end radius fractures and cannot conclude on superiority of one treatment modality over another. So, a larger scaled study and a more comparative study will be needed to substantiate these findings.

Recommendations

Based on the findings from the study, a few recommendations can be given as follows:

1. **Occupational Health Awareness:** Implement training programs to raise awareness among workers about potential occupational health hazards, emphasizing safe work practices and personal protective measures.
2. **Regular Health Check-ups:** Establish regular health check-ups for workers to detect and address health issues at an early stage. This can help in timely intervention and prevention of complications.
3. **Safe Work Environment:** Prioritize the provision of appropriate equipment and tools that minimize the risk of injuries, particularly when handling needles, glass materials, and heavy machinery.
4. **Blood Pressure Management:** Emphasize the importance of blood pressure control through lifestyle modifications, such as reducing salt intake, managing stress, and staying physically active.
5. **Education on Obesity:** Raise awareness about the risks associated with obesity and its potential impact on blood pressure. Provide resources to support weight management and healthy lifestyle choices.
6. **Government and Employer Involvement:** Collaborate with government bodies, employers, and health organizations to create comprehensive policies and initiatives that prioritize the well-being of municipal waste workers.

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Source of Support: None

Conflict of Interest: None declared

How to cite: Patil N, Nizam M. Functional and Radiological Outcome in Lower End Radius Fractures- Our Experience. GAIMS J Med Sci 2024;4(1):92-102.

https://doi.org/10.5281/zenodo.10208296